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Astronomy and Space Science Series

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NOTE

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If you find page references near the right hand margin of this standard they indicate the pagination of the official, printed version of this standard. For example, a notation "Page 2, 4/88, TS-87" would mean that (1) page two of the printed version begins here, (2) the date of issuance was 4/88, and (3) the Transmittal Sheet number was TS-87.

Astronomy and Space Science Series

GS-1330

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SERIES DEFINITION

This series includes professional positions requiring primarily application of the principles and techniques of astronomy and physics in the investigation and interpretation of the physical properties, composition, evolution, position, distance, and motion of extraterrestial bodies and particles in space.

COVERAGE

Astronomy and space science spans a wide range of specialty areas concerned with the dynamic and physical properties of celestial bodies and fields and particles in the space environment. The objects of study include the sun, planets, interplanetary and interstellar media, stars, galaxies, quasars, pulsars, neutron stars, and X-ray sources. In general, the occupation covers extraterrestial exploration and investigation included in such disciplines as astronomy, physics, and planetary and space science.

This science seeks to describe and understand the physical processes of the solar system and the universe primarily through observation and study of the electromagnetic radiations (i.e., thermal, light, radio, infrared, ultraviolet, X-ray and gamma ray) coming from celestial bodies and space matter. Explanation of the observations and the processes taking place to produce such phenomena, behavior and characteristics is interpreted by the laws of physics. Positions in this occupation require a thorough grounding in the theories, principles and techniques of such fields as astronomy, astrophysics, physics, mathematics, chemistry, and related physical sciences.

Scientists in this occupation specialize in one or more of a wide range of functions including observation, interpretation, theoretical analysis, experimentation, and development of instrumentation. To some extent, experimentation may be carried out in laboratories. However, much of what is observed cannot be simulated or produced in the laboratory, since the scale is so great and the energies so enormous. In some instances, space itself becomes the laboratory for investigations and experiments not feasible on earth.

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Programs of astronomy and space science in the Federal service involve:

(1) development of new astronomical and space science techniques and methods and refinement of existing ones;

(2) fundamental research on the constituents, properties, processes and life history of astronomical objects and space matter;

(3) continuing, long-term collection and analysis of data on astronomical and space phenomena that must be observed over long periods of time to be studied effectively, or that must be monitored on a continuous basis as a public or scientific service.

RELATIONSHIP TO OTHER OCCUPATIONS

Astronomy and space science does not have exact and precise boundaries. It includes a wide range of topics within a variety of specialized physical science fields such as classical mechanics, magnetic and gravitational fields, nuclear processes, electromagnetic radiation, atomic and molecular structure, and others. It overlaps and impinges upon a variety of discrete physical sciences. A wide variety of topics in classical and modern physics have a major role in this occupation, particularly with respect to plasma effects, behavior of gases, and the emission, transmission and absorption of radiant energy.

This occupation particularly overlaps physics and geophysics subjects and techniques in regard to the study of incoming radiations on the earth's atmosphere, the investigation of magnetic fields and energetic particles in the interplanetary medium and the investigation of solar flares. Other sciences, such as meteorology and geology, will be concerned with the effects of the same phenomena. Some phenomena can best be understood as they relate to events observed in the physical processes of earth; for example, the composition and structure of planetary atmospheres and exploration of the surface characteristics of the moon.

Similarly, precise boundaries cannot be drawn between this occupation and engineering occupations, e.g., aerospace, mechanical and electrical, in the area of instrumentation. The development and improvement of instruments are often an integral part of the scientific study itself. In other instances, the techniques and requirements for instruments to detect, collect, and analyze the phenomena being investigated are established by astronomers and space scientists, while the development and redesign of the instruments themselves are carried out by engineers or other scientists. For example, astronomers characteristically design the optics portion of an optical telescope, while engineers design the mechanical and electronic portions. However, some astronomers are also specialists in electronic techniques particularly with respect to instruments for photoelectric photometry, and radio astronomy. Characteristically, astronomers and space scientists are deeply involved in the instrumentation aspects of telescopes, detectors and sensors mounted on rockets, satellites, and balloons.

Therefore, in making series determinations, consideration should be given to the purpose of the work, areas of scientific investigation, methodology employed, lines of promotions and career patterns and the field(s) of knowledge in which full professional competence is required.

The fields of geodesy, geology, geophysics, meteorology, mathematics, and physics, aerospace engineering, and electronic engineering are recognized in the Federal service as

occupations separate and distinct from astronomy and space science. Professional positions for which the paramount requirement is full professional competence in one of these fields are excluded. However, professional positions which require professional competence primarily in astronomy, astrophysics, or space physics in addition to competence in one of these fields are included in the astronomy and space science occupation.
In general, positions excluded from the occupation are those primarily concerned with:

(1) solar-terrestial relationships which deal with the effects and interactions of space phenomena on the earth and its atmosphere rather than the courses and nature of the phenomena itself. (Such work is included in other occupations such as Meteorology, Geophysics, Physics.)

(2) the direct application to extraterrestial bodies (i.e., moon, meteorites) of the principles and techniques used in exploration and investigation of the constitution and properties of the earth. (Such work is included in other occupations such as Geology, Geophysics, Chemistry.)

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SPECIALIZATIONS AND TITLES

Specializations

Astronomers and space scientists typically specialize with respect to particular phenomena and observational techniques. Specializations are established to reflect a broad primary division of subject matter. Although many topics within each speciality have been identified, the coverage is not exhaustive. Those appearing represent current major efforts underway in the various Federal agencies.

Astronomy: This specialization includes positions concerned with observing and describing celestial objects; determining the positions, the motions and gravitational interactions of celestial objects; and investigating related aspects of stellar and galactic dynamics.

Astronomers in the field of astrometry make precise determinations of positions, distances, and motions of celestial objects. They develop catalogs of star positions for various purposes such as time standards, navigation, and geodetic coordinate systems. They provide fundamental data for other topics of astronomy (e.g., proper motions, masses, radii).

Astronomers in the field of celestial mechanics deal with the motions of the planets and satellites under action of gravitation. They also establish the masses of the planets and satellites, the internal-density distribution of the planets, and the mechanical stability of the systems.

Astronomers use a variety of optical telescopes equipped with photometric and digital instrumentation to record and perform preliminary analysis of the data. They use measuring engines with varying degrees of precision to measure the plates for analysis and interpretation.

Astrophysics: This specialization includes positions concerned with applying the laws of physics to a wide range of topics dealing with the state and condition of matter in space. Astrophysicists seek to understand the energy sources, generation, transmission and radiative properties from astronomical bodies, including the mechanisms and interactions in the interstellar and interplanetary mediums. They make studies of emissions over the entire spectrum of electromagnetic radiation. They make observations above the earth's atmosphere by probes, balloons and satellites in studying the ultraviolet, X-ray, gamma ray and cosmic ray regions from solar and non-solar sources.

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Major areas of investigation include:

-- Structure of the sun's atmosphere and interior; solar activity; atomic and nuclear processes inside the sun and on its surface; origin and behavior of solar magnetism and solar cosmic rays;

-- Physical properties of stellar atmospheres and interiors; energy generation by nuclear processes; stellar origin and evolution; luminosities of stars, clusters and population differences; physical processes of peculiar and variable stars (e.g.), noval, supernova, binaries, multiple stars);

-- Physical processes and properties of gas and dust in interplanetary and interstellar medium and their chemical composition; interactions between stars, interstellar medium and gaseous nebulae;

-- Structure, evolution, distance scale, and age of galaxies and the universe; interactions between close pairs of galaxies and processes in colliding galaxies.

Radio Astronomy: This specialization includes positions using radio telescopes with various techniques to detect and investigate radiations in the radio region of the electromagnetic spectrum.

Radio astronomers make observations to detect and map the sources, intensities, polarization and direction of radio frequency emissions. They measure atomic and molecular spectral lines in the radio wave lengths; they use radar techniques to determine and map distances to planets and other objects. Typically, radio astronomers develop instrumental techniques to improve resolution and sensitivity of observations.

Radio astronomers investigate unknown physical processes such as sources of cosmic radio radiation in quasars, pulsars, radio galaxies and nebulae. They determine the temperatures, surface characteristics, atmospheric constituents, and other physical characteristics by measuring and analyzing the natural radio emission of planets. Radio astronomers use radio and radar techniques to trace and understand solar active regions, solar flare physics and chronology, and the variations in energy rates between the corona and solar wind.

Space Science: This specialization includes positions concerned with investigations of solid bodies within the solar system; with the effect of solar radiation on these bodies and the space environment; and with subjects not included in the other specializations. Major areas of investigation include:

-- Physical properties and characteristics of the planets (except earth); processes by which planets and other condensed bodies originate and stabilize; structure of elements in planetary interiors and atmospheres;

-- Effect of general outpouring of matter and energy from the sun which controls such phenomena as interplanetary environment, planetary surfaces, atmospheres, radiation belts, solar wind, earth's magnetosphere.

Space scientists make studies to determine the interactions of solar phenomena with the properties and processes of space and the terrestial atmosphere. They investigate the sources and means of propagation of the disturbance and develop techniques to improve the prediction capability for sun-induced disturbances in space. Space scientists make predictions and forecasts of solar events and space disturbances from data collected by continuous observations of the sun.

Investigation of solar-terrestial relationships includes a wide area of topics important to such occupations as physics, geophysics and geochemistry. Similarly, studies of solid bodies, meteorites and planetary interiors and surface characteristics relate to various fields of geology. Included in this specialization are positions primarily investigating these topics by astronomical techniques including rocket and satellite-borne instruments.

TITLES

Specialized titles are established for positions at all grade levels, including GS-5, because of differences in the knowledges required for the work. The following titles are to be used for nonsupervisory positions:

Astronomer for positions in the Astronomy specialization;

Astrophysicist for positions in the Astrophysics specialization;

Radio Astronomer for positions in the Radio Astronomy specialization;

Space Scientist for positions in the Space Science specialization.

The prefix *Supervisory* should be used in the title of positions that require supervisory qualifications.

This series includes a number of distinctive areas of work. To be precise, the series title should be the Astronomy, Astrophysics, Radio Astronomy, and Space Science Series. Ideally, it would be desirable to use a simpler title such as Astronomy Series (recommended by some reviewers of the draft standard). However, we need a title to show clearly the changes that have taken place in this occupation. The Astronomy and Space Science title of the occupation represents a reconciliation of conflicting viewpoints, is in current use, reflects the broad educational requirements, and is found to be generally preferred.

DETERMINING WHICH STANDARD TO USE

Astronomy and space science positions involve a broad spectrum of work in many functional areas. The grade-evaluation criteria contained in this standard are to be used for evaluating positions primarily involved in making observations, analyzing and interpreting data, or other functions not covered by the guides listed below. Positions of astronomers and space scientists in the functions listed below are to be evaluated by the appropriate grade-evaluation guides:

Research: Positions engaged in performing basic and applied research should be evaluated by reference to the Research Grade-Evaluation Guide.

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Research Grants: Positions engaged in reviewing, evaluating, and recommending approval of research grants and contracts should be evaluated by reference to the Research Grants Grade-Evaluation Guide.

Development: Positions engaged in the development of new telescopes and associated instrumentation (ground or satellite), probes and other instrumentation and techniques should be evaluated by reference to the Equipment Development Grade-Evaluation Guide.

Test and Evaluation: Positions engaged primarily in planning, performing, evaluating and reporting tests of instrumentation for telescopes, probes, spacecraft, and data reduction should be evaluated by reference to the Test and Evaluation Engineering Grade-Evaluation Guide, GS-800.

Education:	Positions engaged in education programs should be evaluated by reference to the Multiseries Standard for the Classification of Positions in the Field of Education and Training, GS-1710/1712.
Supervision:	Supervisory positions should be evaluated by reference to the Supervisory Grade-Evaluation Guide, Part II.

FUNCTIONS COVERED BY THIS STANDARD

Positions to be evaluated by this standard perform nonsupervisory professional work involved in compiling, comparing, classifying and analyzing data obtained in long-term observational programs. Approaches and methods of observing must be consistent over long periods of time in order to obtain reliable, precise data for interpretations. Work performed is typically concerned with improving the accuracy and quality of the scientific instruments, techniques and data produced. For example, studies are undertaken to incorporate additional variables, to refine analytical techniques, and to eliminate systematic errors.

Most positions are engaged in continuing programs of observations, such as (1) greater accuracy of and additions to celestial coordinate systems, (2) precisely positioning, classifying, and predicting the movements of celestial objects, (3) searching for and monitoring sources of specific radiation (e.g., radio emissions or sunspots), and (4) detecting additional properties of the radiations from celestial objects (e.g., determining the chemical abundances, temperatures, and densities of stars from their optical spectra). Other work may involve studies to interpret findings, incorporate advances in the field, resolve problems of instrumentation and data, or define areas for further investigation.

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CLASSIFICATION FACTORS

The following criteria are used to determine the grade level of positions covered by this standard:

(1) Nature of the assignment, and

(2) Level of responsibility.

These are described for each grade level in this standard. Qualification requirements have not been described separately but rather have been reflected as appropriate in both the "Nature of the Assignment" and "Level of Responsibility" factors.

Nature of the Assignment

This factor deals with the nature, variety and purpose of functions performed; the complexity, scope and difficulty of the work; the degree of judgment and kinds of skills and knowledges required in carrying out assignments.

At the lower levels, assignments are typically designed to acquaint the scientist with the basic techniques, methods, and procedures used in gathering and analyzing astronomical and space science data including the theory and operation of instruments. Assignments at the higher

levels involve analysis, evaluation and interpretation of observational data and behavior phenomena, and preparation of scientific tables, papers and reports for publication.

The level of difficulty of assignments is affected by the existence of established guidelines and the ease with which they can be applied. This is true for basic astronomical and space data. For example, the availability of data, the ease with which it can be acquired, the reliability of available data -- all affect the difficulty and scope of assignments. The degree to which the scientist participates in identifying and resolving problems is also important.

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Level of Responsibility

This factor reflects the nature and extent of supervisory control exercised over the work; the nature of available guidelines; the nature and significance of personal contacts; and the nature and significance of recommendations and findings.

The degree of control may be measured by the extent to which the employee receives guidance in assignments and the degree of freedom exercised in --

(1) planning and organizing the work;

(2) developing approaches, techniques and guidelines;

(3) drawing conclusions and presenting findings.

Accuracy and precision of scientific methods and techniques is significant at all levels. Differences in grade levels may be reflected by the degree to which the scientist is held accountable for the effectiveness of approach, the adequacy of treatment, the accuracy of analysis, the validity of interpretations, and the significance of findings.

At the lower levels scientists use standard methods and techniques. They have little leeway for decision other than recognizing deviations in methods or from anticipated results based on accepted theories and application of precedents. At the higher levels scientists make recommendations and decisions based on their evaluation and interpretation of the significance of new knowledge and understanding; develop improvements in observational and analytical techniques, and accept or reject findings for the specific purposes of the assignment.

EVALUATION NOTES

This standard provides specific grade-level criteria for nonsupervisory positions in grades GS-5 through GS-13. Specific criteria for grades above GS-13 are not provided because such

positions in functions covered by this standard are too few in number and too individualized for the development of separate specific grade-level guidance. However, positions having duties and responsibilities that clearly and significantly exceed the criteria for grade GS-13 should be classified to the appropriate higher grade by extension of the criteria in this standard and the application of sound classification principles, or by use of the Research or other grade evaluation guides.

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For simplicity in wording, we are using the term "scientist" for astronomer, astrophysicist, radio astronomer, and space scientist.

GRADE LEVELS
Astronomer GS-1330-5
Astrophysicist GS-1330-5
Radio Astronomer GS-1330-5
Space Scientist GS-1330-5

Nature of the Assignment

This is the basic trainee level. Assignments provide intensive training in the methods involved in the collection and analysis of data about astronomical objects and space phenomena.

GS-5 scientists may perform a variety of tasks in well-defined operations such as observations, mensuration, computation and data reduction. Assignments are selected to augment the professional training of scientists in the basic principles and theories of astronomy, mathematics, and the physical processes of the universe by:

(1) providing familiarity and skill in the use of laboratory, observatory, or field scientific instruments;

(2) acquainting trainees with the professional methods and techniques for obtaining and processing space data;

(3) providing experience in the elementary standard analysis of scientific data.

Level of Responsibility

GS-5 scientists receive detailed instructions on all aspects of the work. The procedures, techniques, equipment and results expected are specified. Guidelines, methods, and practices are well established for assignments at this level. Work efforts are reviewed during process

and upon completion for technical accuracy and proper application of procedures and principles.

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Astronomer GS-1330-7
Astrophysicist GS-1330-7
Radio Astronomer GS-1330-7
Space Scientist GS-1330-7

Nature of the Assignment

GS-7 scientists receive assignments to develop skill in investigative and analytical methods and techniques. They typically are assigned various tasks in a sequence of steps that require skill and precision in carrying out standard observations, measurements, and preliminary analysis of data.

As at the GS-5 level, GS-7 scientists primarily compile, observe, classify and compute factual evidence of physical processes and other phenomena. The difference lies in the greater skill in the performance of a wider range of related tasks and the use of somewhat intricate techniques for data reduction. Judgment based on standard astronomical and physical theory and mathematical concepts is required to (a) check for errors, (b) correlate changes in instruments, atmospheric conditions and similar specified factors with observations, and (c) ascertain that data is valid for the particular purposes of the assignment.

GS-7 scientists in organizations having observational facilities typically become familiar with the precise use of the various telescopes and instruments for specific observational programs. They may perform observing duties as an assistant to a higher-level scientist or stand a regular watch. Typically, GS-7 scientists perform a variety of tasks such as measuring plates, extracting and correlating data from various sources, preparing data in suitable form for reduction, making calculations, writing routine computer programs for data reduction.

Typical of assignments performed are the following:

1. For a data reduction program to determine positions of reference stars

    -- reviews and edits microfilm records of observations to delete false and poor quality records;

    -- inserts data recorded elsewhere by observers, such as observing conditions, times, instrument constants;

-- makes appropriate checks, verifies such card punch records of the data, and applies programing routines to eliminate errors.

2. Using standard practices and established mathematical formulas, performs such tasks as:

   -- computation of mean errors of observations;

   -- tabulation of data according to one or more schemes to depict some characteristic;

   -- hand reduction of observations which for some reason have given trouble;

   -- preparation of plots, charts and curves of data to visually demonstrate the behavior of the telescope, the consistency of observations or the practices of observers.

3. Performs preliminary analysis and makes computations in data-reduction phases of problems in positional astronomy, classical mechanics and geodesy using established methods and routines:

   -- reads and interprets observational data from designated sources;

   -- extracts information in suitable form for computation;

   -- prepares and checks data input for small-scale computer;

   -- prepares and checks matrices for computation by large-scale computer.

Level of Responsibility

On familiar tasks GS-7 scientists carry out standard work procedures without detailed instructions. They are given specific instructions with each new assignment. The work is spot-checked in progress. The supervisor gives guidance and further instructions as unfamiliar aspects and difficulties are encountered.

A significant difference from the GS-5 level is that GS-7 scientists are held accountable for the accurate application of methods and techniques (i.e., measurement, mathematical, programing, and observational) and for following specified procedures without step-by-step guidance.

Completed work is reviewed for consistency, accuracy, and thoroughness of the techniques and methods applied. GS-7 scientists are expected to become familiar with the use of computers and the nature of the observational and investigative procedures.

Astronomer GS-1330-9
Astrophysicist GS-1330-9
Radio Astronomer GS-1330-9
Space Scientist GS-1330-9

Nature of the Assignment

Assignments are typically-well defined units or segments of projects assigned higher-level scientists. GS-9 scientists collect and analyze data for a specific observational program or investigative study. Assignments typically require proficiency in the underlying theory and standard methodologies of both observational techniques and analytical processes for given purposes.

GS-9 scientists perform observing duties similar to those described at the GS-7 level. In addition, they select objects in the program to be observed, and perform various maintenance operations and adjustments of the instruments. Whereas GS-7 scientists carry out specified tasks as assigned in preliminary analysis of observational data, GS-9 scientists are expected to apply judgment based on familiarity with the theory and operation of the observational program in carrying out a variety of processes used to compile, compare and validate the data. They make minor adaptations in astronomical, physical and mathematical techniques to fit varying conditions and to obtain accurate findings. Judgment is required to make sure that observations and measurements are in line with expected model of phenomena behavior and with previous data.

Typical of assignments performed are the following:

1. Performs reduction of transit circle observation of positions of stars and other celestial objects including mathematical steps to derive the right ascension and declination of a star. Carries out procedures such as correcting for instrumental and orientation errors, and astronomical refraction. Applies appropriate methods to account for the effects of precession, nutation, and aberration on astronomical observations.

2. Compiles data on stars from different catalogs for inclusion in a geodetic program. Ascertains by comparative study whether inconsistencies are due to such causes as different computational methods, random errors, instrumental differences. Makes such determinations by use of standard mathematical and statistical methods applicable to positional astronomy.

3. Performs limited studies to maintain scientific precision of observations; for example, checks on the accuracy of operation of instruments, investigates quality of photographic

emulsions, and evaluates the effect of atmospheric or other conditions which could be affecting the observational data.

Level of Responsibility

Assignments are given in terms of their purpose and the results to be achieved. When precedent data, studies and techniques are not apparent, the supervisor provides advice on the sources of information and the methods to be used. For special investigations and new assignments, the supervisor gives detailed instructions and closely follows their application to the assignment. For recurring assignments, such as collection and analysis of measurements of specific characteristics, GS-9 scientists are responsible for following prescribed methods and guidelines with great accuracy and for recognizing factors, conditions and results that may affect the findings.

The GS-9 level differs from the GS-7 level primarily in that the GS-9 scientist organizes and carries out assignments involving various standard work processes largely on his own. By comparison, the GS-7 scientist carries out individual tasks.

GS-9 scientists are expected to seek supervisory assistance when difficulties arise in achieving consistency in methods, procedures or data. They report significant deviations from anticipated results as they occur. Completed work is reviewed for technical proficiency, validity and adequacy.

GS-9 scientists serve as a source of information on their assignments primarily to others working in the program. They discuss specific problems about the instruments, work processes and procedures as necessary with others such as technicians and programers.

Astronomer GS-1330-11
Astrophysicist GS-1330-11
Radio Astronomer GS-1330-11
Space Scientist GS-1330-11

Nature of the Assignment

GS-11 assignments require sound judgment and professional competence in the conventional methods and techniques used to gather, analyze, and interpret observational data in a complex specialized field. In addition to the accumulation and analytical treatment of data typical of the GS-9 level, GS-11 scientists evaluate and interpret such data within the context of an ongoing program, current theories, and accepted approaches.

Typically, GS-11 assignments, while varied, are a part of a larger program or study such as providing a data baseline, improving analytical procedures for data input and treatment, deriving mathematical formulation and computational techniques, investigating problems of instrumentation performance, or performing limited studies of findings. GS-11 scientists select and use a variety of methods, techniques, and processes to produce explicit findings and discriminating evaluations. Originality is limited largely to the modification or logical extension of standard, albeit complex, scientific methods and techniques.

GS-11 scientists judge the significance of their data and techniques for various scientific purposes, and recognize the impact of findings and techniques from related programs and specialties. They investigate conditions and factors which may be producing errors or anomalies. They assess the validity of different scientific procedures and techniques to correct errors or improve results in the data, instruments, and methods.

Typical of assignments performed are the following:

1. Prepares scientific data for publication concerning a continuing study of double stars:

   -- selects scientific data being accumulated by a continuing program of observations;

   -- computes orbits of double stars in order to detect unseen companions; and

   -- discusses accuracy and precision of double star measures.

2. Plans and carries out analyses and preparation of data for specified sections of astronomical publication for navigation purposes, e.g., for the Air Almanac: (a) sky diagrams of all available objects, and (b) moonlight graphs for high geographic regions:

   -- selects appropriate data and factors;

   -- determines mathematical formulation to incorporate appropriate spherical and theoretical astronomy for the problem; and

   -- carries out or directs assistants as assigned in compiling, comparing, computing, and processing and presenting data.

3. In a program to establish the positions of southern reference stars is responsible for processing observations from foreign observatories to obtain the apparent place, refraction and instrumental reductions:

   -- reviews incoming data to determine acceptability in program;

-- establishes checks for each computer run to insure that all results fall within prescribed limits of accuracy; and

-- investigates and resolves problems, or questionable results.

4. In a Radio Astronomy program plans and carries out short-term observational program to search for specific phenomena to complement or verify observations made by optical telescopes:

-- adapts and calibrates instruments to perform observations in manner desired;

-- reduces data to suitable form for analysis, evaluation and interpretation; and

-- prepares report of techniques used and findings.

Level of Responsibility

GS-11 scientists receive assignments primarily given in terms of the scope, objectives, and long-range problems which may be encountered. By comparison, GS-9 scientists are given the purpose and the results to be obtained. They discuss with the supervisor approaches, plans, and methods for assignments involving special studies or new investigations. Completed work is reviewed for technical adequacy and validity. At this level, interpretations as well as findings are expected to be those of a trained scientist and to be consistent with other data and processes involved.

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GS-11 scientists serve as a source of information on their assignments to scientists within and outside the organization. They discuss their methods, procedures, and findings with others as appropriate.

Astronomer GS-1330-12
Astrophysicist GS-1330-12
Radio Astronomer GS-1330-12
Space Scientist GS-1330-12

Nature of the Assignment

GS-12 scientists plan and carry out assignments requiring competence across a range of functions for a continuing observational program or for indepth studies in a specialized field, e.g., instrumental techniques, proper motion of particular classes of astronomical objects, catalog of star positions, phenomena of solar flares, etc.

GS-12 scientists typically coordinate several related areas of a broad program or study which are critical to the overall undertaking. Frequently, they serve as team leaders for specific projects or investigation directing the efforts of professional and nonprofessional employees assigned. At the GS-12 level, guidelines and precedents applicable to the more demanding assignments are typically inadequate, inappropriate, or lacking in some vital aspects. By comparison, at GS-11 guidelines and precedents are generally more easily adaptable to assignments. Typically, GS-12 scientists perform studies and investigations to improve the state of the art relating to their area of assignment with respect to:

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-- improving the application of techniques and instrumentation;

-- enhancing precision and accuracy of methods and findings,

-- incorporating advanced knowledge of processes, phenomena behavior and properties of the subject matter.

Typical of assignments performed are the following:

1. Performs a variety of functions in using radio astronomy techniques to investigate various phenomena:

   -- provides instrumentation support for a research project investigating a new molecular spectral line. Advises the principal investigator on changes and adaptation of instrumentation needed to perform the desired function;

   -- designs instruments (e.g., radiometer), and searches out and incorporates other instruments and techniques into the system; and

   -- directs the instrumentation aspects of the project such as building devices, installation, calibration, check out, operation, etc.

2. Investigates astro-geodetic problems in astronomy such as:

   -- develops procedures for processing and reducing photographic plates from various observational programs to obtain a homogeneous stellar control system;

   -- explores the problem of inter-comparing several existing star catalogs to put them on a unified system; and

   -- plans new techniques for improved astrophotography. Develops a method to remove unwanted stars from a large star field.

3. Performs special assignments to improve methods and techniques of a long-term observational program:

   -- plans the computerization of a visual-manual technique of observing to insure smooth transition between the two systems;
   -- advises designers of automated system on problems in adapting and correlating the new system to the current overall system; and

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   -- plans and monitors the development of new programs and techniques to analyze and interpret data.

Level of Responsibility

Assignments are given in general terms of the objectives or problems to be investigated. GS-12 scientists plan and organize the work processes involved in the assignment and determine what improvements in approach and treatment should be explored. They are responsible for fitting their work into a larger context of investigation or exposition. By comparison, GS-11 scientists plan and organize work processes that are normally within the framework of established approaches and techniques.

GS-12 scientists are responsible not only for the accuracy and precision of the scientific data but also for the thoroughness of the investigative processes and cogency of interpretations. Scientific validity of methods, findings and interpretations is expected at this level. Their work is reviewed primarily in terms of the adequacy of treatment and proficiency with which assignments are pursued. By comparison, the work of GS-11 scientists is reviewed for technical adequacy and validity. Reports of findings, new methods and techniques to be published in scientific literature are typically reviewed by specialists in the field. Personal contacts are similar to those at the GS-11 level.

Astronomer GS-1330-13
Astrophysicist GS-1330-13
Radio Astronomer GS-1330-13
Space Scientist GS-1330-13

Nature of the Assignment

GS-13 scientists serve as specialists in a complex area of work or subject matter. Typically, they formulate, plan and execute major advanced studies or long-term projects.

The skill and technical expertise of GS-13 scientists are such that they undertake investigations of problems that have not been previously resolved in a general problem area

of the field. They develop new approaches in long-range observational programs. Assignments require a thorough understanding of the subject as well as competence in a variety of complex instrumentation, mathematical, information handling and other techniques of related fields. By comparison, the work of GS-12 scientists require primarily competence in the processes and techniques used in studies in their area of assignment.

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GS-13 scientists structure problems for systematic investigation and intensive analysis to carry out work in the field to a more definitive state and to expand knowledge to a further stage. By comparison, the work of GS-12 scientists involves changes and problem solving with respect to particular aspects of the assignment rather than the overall project. Typically, GS-13 scientists establish program concepts and guidelines for pursuing other lines of attack. Complexities typically involve:

-- development of new techniques and methods for the solution of unresolved questions;

-- application of a high degree of insight to define critical features of the long-range problem; and

-- application of considerable resourcefulness to adapt, extend and synthesize existing theory and techniques into new patterns.

Typical of assignments performed are the following:

1. As specialist and project leader for the development of star catalogs, performs studies to establish the system and methods for formulating catalogs of positions and proper motions of stars:

   -- develops the basic system and method for combining the results from several international observatories into a homogeneous catalog of final positions for reference stars; and

   -- analyzes observations to establish the characteristics and errors peculiar to each instrument and observational program; and

   -- develops new approaches to make more exhaustive use of observational data with a greater degree of accuracy than now exists in other catalogs.

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2. As a specialist in instrumentation for a continuing observational program performs studies to update, improve, and modernize a variety of complex and unique instruments:

-- evaluates trends in observing programs, needs for new data, developments in techniques and equipment, etc.;

-- investigates areas that appear to need improvement and modernization; and

-- evaluates concepts and changes in instrumentation, techniques, etc., to achieve new capabilities.

Level of Responsibility

Work at the GS-13 level is performed with a marked degree of professional independence and technical expertise. GS-13 scientists determine the approaches to be used and are responsible for the results. In comparison, GS-12 scientists ascertain the nature of problems and make preliminary analyses of the means to resolve them. The work performed is expected to be a finished product reflecting a high order of professional competence as to adequacy and critical evaluation. GS-13 scientists keep the supervisor informed of progress and direction of the work.

Supervisory control is limited to approval of the overall approach, priorities, schedules, and staff requirements. Findings and recommendations that change approaches, methods, and significant procedures in the field or plans in the execution of continuing programs are approved by higher levels of management. By comparison, GS-12 scientists' work is reviewed in terms of adequacy of treatment of and proficiency with which studies are carried out.

GS-13 scientists represent their organization in giving advice or working on cooperative ventures in technical and program matters such as international efforts to develop new astronomical and space data and techniques.